



## As bridge engineers, are we designing efficient structures?

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### Abstract

As bridge engineers we should be designing efficient structures, minimising waste and by default minimising carbon emission, but are we?

The paper will look at how design codes define actions and resistances. For actions in particular, some examples of onerous loading requirements will be discussed and how as engineers – particularly in the current climate of reducing carbon emissions – we should be able to challenge some of these requirements.

Some illustrative examples of plate girder bridges will be considered to demonstrate how different interpretation of the design codes can lead to different arrangements of plate thicknesses, stiffeners and weld configurations and will explore the impact these may have on fabrication and construction, cost and embodied carbon.

**Keywords:** bridges; steelwork; concrete; net zero; carbon; design codes, estimate.

### 1 Introduction

As bridge engineers we should be designing efficient structures, minimising waste and by default minimising carbon emission, but are we?

At Cass Hayward we have been designing and undertaking independent design checking of bridges – predominately in the UK - for over 40 years and have seen a variety of schemes over this time period.

Historically what we would have considered as efficient was a design which gave our Contractor clients the most competitive solution in a Design and Build tender, but is this how efficient bridge designs should be measured?

This leads to the title of the paper – What is an efficient bridge design?

Different roles (Clients, Developers, Asset Managers, Contractors, Designers) may consider this question and come up with a range of answers see Figure 1.

This paper will explore the question by considering if our Codes of Practice for loadings are becoming too onerous or conservative; and looking at a simple bridge design with varying properties to measure some of the key metrics noted above.

### 2 Are our Codes of Practice too onerous?

#### 2.1 Role of Independent Design Checker

For Highway and Rail Design in the UK, the role of the independent checker is defined in the appropriate Engineering Assurance documents [1] & [2] and is predominately a check that the designer has provided a structure which is strong enough to carry the loads over the road/ railway / river etc. and is compliant with standards.

However, the scope of the checker is not to advise on elements which are “over designed” but to confirm “if it works”. Examples of such scenarios are noted in Table 1.